WE CLAIM:

-1-

A mesostructured crystalline hydrated alumina composition exhibiting at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation wherein λ is 0.1541 nm corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g.

-2-

The composition of Claim 1 selected from the group consisting of boehmite, pseudoboehmite, and mixtures thereof.

-3-

A mesostructured crystalline hydrated alumina and organic modifier composite composition wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice.

-4-

The hydrated alumina and organic modifier composite composition of Claim 3 wherein the organic modifier component is a non-ionic surfactant.

-5-

The composition of Claim 4 wherein the surfactant is selected from the group consisting of a polyethylene oxide block co-polymer, an alkylene amine; an alkylene polyamine, a polypropylene oxide amine, and a polypropylene oxide polyamine and mixtures thereof.

-6-

The composition of Claims 3, 4 and 5 wherein the hydrated alumina component is selected from the group consisting of boehmite, pseudoboehmite and mixtures thereof.

-7-

A mesostructured crystalline transition alumina composition:

wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation where λ is 0.1541 nm corresponding to an ordered oxygen atom lattice with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g.

-8-

The mesostructured transition alumina of Claim 7 wherein the transition alumina is selected from the group consisting of gamma, delta, theta, *eta, chi, and rho* alumina and mixtures thereof.

-9-

A process for the preparation of a mesostructured hydrated alumina - organic modifier composite composition which comprises:

(a) reacting an alumina precursor selected from the group consisting of aluminum salts, oligomeric oxyhydroxyaluminum cations, non-ionic aluminum molecules and mixtures thereof in solution with hydroxide ions in the presence of an organic modifier at a temperature between 0° and 200°C for a period of time sufficient to cause crystallization; and

(b) filtering, washing and drying the product.

-10-

A process for the preparation of a mesostructured hydrated alumina composition which comprises:

(a) adding a stoichiometric quantity of water to an aluminum alkoxide, optionally in alcohol solution, at a temperature between 0° and about 100°C for a period of time sufficient to cause hydrolysis of the aluminum alkoxide and crystallization of the mesostructured hydrated alumina phase; and

(b) filtering, washing and drying the product in air.

-11-

A process for the preparation of the mesostructured hydrated alumina composition exhibiting at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation wherein λ is 0.1541 nm corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g; which comprises treating a mesostructured crystalline hydrated alumina and organic modifier composite composition, wherein the composition exhibits at least one narrow angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice, so that the organic modifier is removed by solvent extraction, thermal treatment, or a combination of solvent extraction and thermal treatment.

-12-

The process of Claim 11 wherein the hydrated alumina phase is selected from the group consisting of boehmite, pseudoboehmite and mixtures thereof.

-13-

The process of Claim 11 wherein the organic modifier is a non-ionic surfactant.

-14-

The process of claim 13 wherein the organic surfactant is selected from the group consisting of a polyethylene oxide block co-polymer, an alkylene amine; an alkylene polyamine, and a polypropylene oxide amine, and polypropylene oxide polyamine and mixtures thereof.

-15-

A process for the preparation of a mesostructured transition alumina composition which exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation where λ is 0.1541 nm corresponding to an ordered oxygen atom lattice with aluminum in interstitial positions within the lattice; wherein the surface area is at least 200 m^2/g; wherein the pore volume is at least 0.40 cm^3/g;

which comprises heating a mesostructured crystalline hydrated alumina composition exhibiting at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation wherein λ is 0.1541 nm, corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice to a temperature in the range 400 to about 900°C for a period of time to cause dehydration of the hydrated alumina and the formation of the mesostructured form of the transition alumina.

-16-

The process of Claim 15 wherein the transition alumina is selected from the group consisting of gamma, delta, theta, *eta, chi,* and *rho* alumina and mixtures thereof.

-17-

The process of Claim 15 wherein the organic modifier is a non-ionic surfactant.

-18-

The process of Claim 17 wherein the organic surfactant is selected from the group consisting of a polyethylene oxide block co-polymer, an alkylene amine; an alkylene polyamine, a polypropylene oxide amine, polypropylene oxide polyamines and mixtures thereof.

-19-

A process for the formation of a mesostructured transition alumina composition:

wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation where λ is 0.1541 nm, corresponding to an ordered oxygen atom lattice with aluminum in interstitial positions within the lattice;

wherein the surface area is at least 200 m^2/g; and

wherein the pore volume is at least 0.40 cm^3/g which comprises treating a mesostructured crystalline hydrated alumina and organic modifier composite composition, wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice; a to a temperature in the range 400 to about 900°C for a period of time to cause removal of the organic modifier component, dehydration of the hydrated alumina component, and the formation of the mesostructured form of the transition alumina.

-20-

The process of Claim 19 wherein the transition alumina is selected from the group consisting of gamma, delta, theta, eta, chi, and rho alumina and mixtures thereof.

-21-

The process of Claim 19 wherein the hydrated organic modifier is a non-ionic surfactant.

-22-

The process of Claim 21 wherein the surfactant is selected from the group consisting of a polyethylene oxide block co-polymer, an alkylene amine; an alkylene polyamine, and a polypropylene oxide amine, and polypropylene oxide polyamine and mixtures thereof.

In a process for converting a first liquid or gas stream to a second liquid or gas stream using a catalyst, the improvement in which comprises:

using as the catalyst or catalyst component an alumina composition selected from the group consisting of

(a) a mesostructured crystalline hydrated alumina composition exhibiting at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation wherein λ is 0.1541 nm corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g;

(b) a mesostructured crystalline hydrated alumina and organic modifier composite composition wherein the composition exhibits at least one narrow angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice; and

(c) a mesostructured crystalline transition alumina composition: wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation where λ is 0.1541 nm corresponding to an ordered oxygen atom lattice with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g.

-24-

The process of Claim 23 wherein the liquid or gas stream is a hydrocarbon.

-25-

The process of Claim 24 wherein the hydrocarbon is petroleum.

In a process for adsorbing a component from a gas or liquid stream, the improvement in which comprises using as an adsorbent or adsorbent component an alumina composition selected from the group consisting of

(a) a mesostructured crystalline hydrated alumina composition exhibiting at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation wherein λ is 0.1541 nm corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g;

(b) a mesostructured crystalline hydrated alumina and organic modifier composite composition wherein the composition exhibits at least one narrow angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines corresponding to an ordered lattice comprised of oxygen atoms and hydroxide groups with aluminum in interstitial positions within the lattice; and

(c) a mesostructured crystalline transition alumina composition: wherein the composition exhibits at least one low angle x-ray diffraction line corresponding to a lattice spacing of at least 2.0 nm and multiple wide angle x-ray diffraction lines with CuKα radiation where λ is 0.1541 nm corresponding to an ordered oxygen atom lattice with aluminum in interstitial positions within the lattice, wherein the surface area is at least 200 m^2/g; and wherein the pore volume is at least 0.40 cm^3/g.